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Attorney Docket # 5095-13RCE

Patent

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of
Wilfried MODROW et al.
Serial No.: 09/509,807
Filed: April 28, 2000
For: Method For Determining And Controlling Material Flux Of Continuous Cast Slabs

Examiner: Tran, L.
Group Art: 1725

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Alfred W. Froebrich
Signature

June 26, 2003
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APPEAL BRIEF

SIR:

This is an appeal, pursuant to 37 C.F.R. §1.192(a) from the decision of the Examiner in the above-identified application, as set forth in the Final Office Action wherein the Examiner finally rejected appellant's claims. The rejected claims are reproduced in the Appendix A attached hereto. A Notice of Appeal was filed on March 26, 2003. This Appeal Brief is being submitted in triplicate.

The fee of $320.00 for filing an Appeal Brief pursuant to 37 C.F.R. §1.17(f) is submitted herewith. Appellants requests a one-month Extension of Time of the original shortened statutory response period to file this Appeal Brief. A Petition for the one-month extension of time is

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enclosed herewith along with the fee of $110. Any additional fees or charges in connection with this application may be charged to our Patent and Trademark Office Deposit Account No. 03-2412.

REAL PARTY IN INTEREST

The assignee, SMS Demag AG, of applicants, Wilfried Modrow, Uwe Quittmann, and Wolfgang Sauer, is the real party of interest in the above-identified U.S. Patent Application.

RELATED APPEALS AND INTERFERENCES

There are no other appeals and/or interferences related to the above-identified application at the present time.

STATUS OF CLAIMS

The application was filed with claims 1-4. A preliminary amendment canceled claims 1-4 and added new claims 5-9. Claims 6, 7, and 9 were cancelled during prosecution and claims 5 and 8 were amended. Claims 5 and 8 have been rejected. Claims 5 and 8 are on appeal.

STATUS OF AMENDMENTS

A Response was filed on January 23, 2003 subsequent to the Final Office Action. In response, on February 27, 2003, the Examiner issued an Advisory Action which indicated that the Response was considered but that the Response did not place the application in condition for allowance.

SUMMARY OF THE INVENTION

Appellants' invention is directed to a method for determining and controlling the material flow of continuous cast slabs in a transport path between a continuous-casting installation and a rolling mill by monitoring and optimizing the temperature profile and the amount of heat of a continuous cast slab on the transport path.

The determination of the temperature profile and the amount of heat starts from knowledge of the temperature of the liquid phase at the mold exit of the continuous casting installation and physical parameters of the slab (page 3, lines 5-10). The physical parameters are preferably the temperature dependent material values density ρ, the specific heat C_ρ, the thermal conductivity λ, and scale properties (see page 5, lines 16-19). The convective mixing of the amount of heat contained in the slab and time dependent heat loss from the inhomogeneously cooling slab to the surrounding medium is then calculated using a mathematical-physical model which uses the temperature of the liquid phase at the mold exit and the physical parameters of the slab as inputs (see page 3, lines 10-14). A two-dimensional finite element method may be used to calculate the mathematical-physical model (page 4, lines 5-8). The result of the calculation and the measured surface temperature of the slab are then used to control the material flow in an existing slab-monitoring system (see page 3, lines 14-17).

The present invention teaches that through evaluation of the profiles of the means slab temperature and selected surfaces temperatures over time, it is subsequently possible to estimate the means slab temperature by measuring the surface temperature (page 6, lines 3-6).

ISSUES

1. Whether claims 5 and 8 are 35 U.S.C. . 103 over Simsek, "Dynamic Simulation of Dual-Line Continuous Strip Processing Operation" ("Simsek") in view of U.S. Patent No. 5,509,460 ("Chun")?

GROUPING OF CLAIMS

The pending claims are 5 and 8, of which claim 5 is independent. The claims are grouped as follows:

Group I -- claims 5 and 8, which stand or fall together.

ARGUMENT

GROUP I (CLAIMS 5 AND 8)

It is respectfully submitted that neither Simsek, Chun, nor the combined teachings thereof disclose or suggest the step of determining a temperature of the liquid phase of the continuous cast slab at a mold exit or the step of controlling material flow of a continuous-cast slab using both the measured surface temperature of the continuous-cast slab <u>and</u> the amount of heat and the temperature profile determined by calculating the convective mixing of the amount of heat and the time-dependent heat loss from the inhomogeneous cooling of the continuous-cast slab, as recited in independent claim 5.

Simsek discloses dynamic simulation of dual-line continuous strip processing operations used for generating designs and analyzing operating strategies for a proposed casting installation. In other words, Simsek discloses a design tool and is not used during actual operation of a plant for controlling material flow of a continuous-cast slab using both the measured surface

temperature of the continuous-cast slab and the amount of heat and the temperature profile determined by calculating the convective mixing of the amount of heat and the time-dependent heat loss from the inhomogeneous cooling of the continuous-cast slab, as recited in independent claim 5. Furthermore, Simsek fails to disclose "determining a temperature of the liquid phase of the continuous-cast slab at a mold exit of the continuous-casting installation", as recited in independent claim 5. Instead, Simsek assumes an entry temperature profile (see the first 8 lines in the paragraph directly below Fig. 4, on page 47 of Simsek).

Chun fails to teach what Simsek lacks for the following reasons: (1) there is no motivation for combining the solid/liquid interface detection method taught by Chun with the simulation process disclosed by Simsek, and (2) Chun fails to teach or suggest "determining a temperature of the liquid phase of the continuous-cast slab at a mold exit of the continuous-casting installation", "measuring a surface temperature of the continuous-cast slab over time", and controlling material flow of a continuous-cast slab using both the measured surface temperature of the continuous-cast slab and the amount of heat and the temperature profile determined by calculating the convective mixing of the amount of heat and the time-dependent heat loss from the inhomogeneous cooling of the continuous-cast slab, as recited in claim 5.

Regarding the first reason, Chun discloses the detection of a solid/liquid interface in a continuous casting process by gamma ray attenuation. Chun teaches that the progression and velocity of the solidification front and its shape determine the crystalline structure of the casting material and, therefore, the mechanical properties of the strand (see col. 1, lines 18-22). The exact profile of the solidification front is also required for optimizing magnetic stirring and soft reduction techniques (see col. 1, lines 22-25). Furthermore, the solidification front limits the casting speed

(col. 1, lines 25-26). At col. 1, line 27, Chun defines the solidification front as the solid/liquid interface. Accordingly, Chun teaches that the determination of the solid/liquid interface is important for determining the characteristics of the strand. Furthermore, Chun teaches away from computer estimation of heat flow for predicting where the solid/liquid interface is located (col. 1, lines 32-37). Chun further states that automatic control of the casting process is <u>not possible</u> using calculations of variables because the calculations can not be performed in real time (col. 1, lines 37-40). Accordingly, it is respectfully submitted that there is no motivation for combining Chun with a computer simulator, such as disclosed by Simsek, to automatically control a continuous-casting process. Since motivation for combining the teachings of the references is a requirement of a *prima facie* rejection, it is respectfully submitted that the combined teachings of fail to establish a *prima facie* case of obviousness with regard to the subject matter recited in claims 5 and 8.

Regarding the second reason, Chun specifically discloses that the solid/liquid interface is the important factor for determining the characteristics of the strand. Accordingly, Chun also teaches away from measuring or determining the temperature of the liquid phase or the surface temperature of the strand. In both the final Office Action and the Advisory Action, the Examiner maintains that that measurement of the solid/liquid interface in Chun explicitly teaches measurement of an outer surface temperature of the strand. However, the solid/liquid interface is based on a variety of factors such as, for example, the rate of withdrawal, the flow rate of coolant, and the temperature of the melt (see col. 1, lines 42-49). Accordingly, it is possible that two strands having similar profiles could have two different outer temperatures because of variations in the values of the other factors. Accordingly, it is respectfully submitted that the measurement of the

solid/liquid interface alone as disclosed by Chun fails to explicitly teach measuring the surface temperature of the strand.

Furthermore, Chun also fails to teach or suggest determining the temperature of the liquid phase of the continuous cast slab, as recited in independent claim 5. In contrast, Chun only determines the interface between the solid and liquid portions of the continuous cast strand and does not disclose measuring the temperature of either portion. In view of the above remarks, it is respectfully submitted that Chun teaches away from measuring temperatures because Chun teaches that the only the shape and position of the solid/liquid interface is required to obtain the required characteristics of the strand.

Chun and the present invention rely on two different methods for determining the temperature profile in a cast strand. In contrast to Chun, which directly measures the shape and position of the solid/liquid interface, the present invention relies on knowledge of the temperature of the liquid phase at the mold exit, calculation of convective mixing of the amount of heat and time-dependent heat loss based on the temperature of the liquid phase and physical parameters of the cast slab, and measurement of the outer surface temperature to determine the amount of heat and temperature profile of the continuous cast slab over time. Since Chun teaches only that the shape and position of the solid/liquid interface is measured, Chun fails to teach or suggest controlling material flow of a continuous-cast slab using both the measured surface temperature of the continuous-cast slab <u>and</u> the amount of heat and the temperature profile determined by calculating the convective mixing of the amount of heat and the time-dependent heat loss from the inhomogeneous cooling of the continuous-cast slab, as recited in independent claim 5.

For the foregoing reasons, it is respectfully submitted that the combined teachings of Simsek and Chun fail to teach or suggest the subject matter recited in claims 5 and 8. The Final Rejection of the claims in Group I should be reversed.

CONCLUSION

For the foregoing reasons, it is respectfully submitted that appellants' claims are not rendered obvious and are, therefore, patentable over the art of record, and the Examiner's rejections should be reversed.

Respectfully submitted,
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APPENDIX

1. - 4. (canceled)

5. (Amended) A method for determining and controlling the material flow of continuous-cast slabs in transport and processing paths between the continuous-casting installation and a rolling mill by monitoring and optimizing the temperature on the transport and processing paths, said method comprising the steps of:

a. determining a temperature of the liquid phase of the continuous-cast slab at a mold exit of the continuous-casting installation and physical parameters of the continuous-cast slab including temperature-dependent material values comprising at least one of density ρ, specific heat C_p, thermal conductivity λ, and scale properties;

b. during the material flow of continuous-cast slabs in the transport and processing paths, measuring a surface temperature of the continuous-cast slab over time and determining an amount of heat and a temperature profile of the continuous-cast slab over time by calculating the convective mixing of the amount of heat contained in the continuous-cast slab and the time-dependent heat loss from the inhomogenously cooling of the continuous-cast slab, wherein the step of calculating comprises using a mathematical-physical model calculated using one of a two-dimensional finite element method, a finite difference method, and software using formulas derived from off-line studies; and

c. controlling the material flow of the continuous-cast slab in the transport and processing paths between the continuous-casting installation and rolling mills via a slab-monitoring system of the continuous-casting installation using the measured surface temperature of the

continuous-cast slab and the amount of heat and the temperature profile determined in said step b. as an input to the slab-monitoring system.

6. - 7. (canceled)

8. (Amended) The method of claim 5, wherein said step c. further comprises automatically controlling the material flow via the slab monitoring system based on the amount of heat and the temperature profile determined in said step b. and the measured surface temperature of the continuous-cast slab.

9. (canceled)